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DUTY ON RAILWAY IRON.

We are favored with a copy of the following letter sent to a distinguished member of the Senate of the United States to lay before the Secretary of the Treasury. It was prepared by a member of a firm largely interested in the iron works of Pennsylvania, also as importers of railroad iron. That there should be a reconsideration of the vote of the last session, relative to the duty on the *edge* rail, every friend of internal improvements and the defence of his country, must admit.

We should suppose the iron masters, would desire to promote and facilitate railways up into the secluded iron districts, to bring their iron to market. The cost of transportation, even in Pennsylvania, where there are many facilities, we understand amounts to $8, or $12 per ton—in fact a prohibition to the manufacturer of the article.

As many railroads have been projected and commenced under the old law, we would give them three years to import their iron free of duty; and then for each successive year for four years, increase the duty to the present rate, which amounts to a prohibition to its importation. We have not a single establishment in this country capable of rolling the *edge* rail,—the machinery for which is very costly—added to all, we should inflict great injury to the public, in parallizing many important railways, without any substantial benefit to the iron master and iron trade of this country.

PHILADELPHIA, JULY 18, 1842.

The subject to which I beg to call your attention, is *railway iron*, which I observe in your tariff bill lately presented to the House of Representatives it is proposed to charge with $30 per ton duty, being almost equivalent to its first cost in England; and if to this be added the expenses of inspection, export duty from England, the freight, insurance, merchant's commission, cartage and all other charges, independently of the expense of transportation to the line of railway, will amount to at least 33 per cent more, will make the cost of the material so high as to interrupt very seriously the importation, and thus interfere most essentially with the further construction of railways in this country, which for the rapid conveyance (at all seasons of the year) of intelligence, travellers and merchandize, as well as for the defence of the country, and to secure domestic quiet, may be considered indispensable, and ought by all means to be encouraged by the federal government. If however the manufacturer of railway iron in this country could be effected within a reasonable time, there might be some inducement for endeavoring to encourage the home production of it, but from the fact that the importation of merchant iron and even pig iron, notwithstanding the high duties on them, I conclude there is not capital and skill enough in this country engaged in making them to supply the demand. This supposition is based on the fact, that for the last five years the annual average importation of these two articles, (pig and bar iron) has been about 100,000 tons. But there has been *no edge railway iron rolled in this country*, and it is not reasonable to expect that any will be until the manufacture of these comparatively raw materials shall be made in sufficient quantity to shut out their farther importation. The cause of no edge railway iron being made here, and why none ought to be expected to be manufactured for some years to come is that it requires more manipulations, more experience, and very much more heavy machinery, more skill and experience in rolling, and is altogether a more expensive article than merchant iron, and cannot be made even in South Wales, under 40 shillings per ton, advance over the price of bar iron, and if our people in Pennsylvania (where iron can be made cheapest in the United States,) were to attempt it, they could not succeed in making it at less than 20 to 25 dollars per ton over the price of bar iron. The manufacture of flat bar railway iron with countersunk holes, and united or square ends, has been attempted in this country, but only at 3 establishments in Pennsylvania, which however have not made exceeding 400 or 500 tons. As

the flat bar railway has been made in this country, I suppose the manufacture may be extended, and therefore I would encourage domestic production, but it being impossible to make *edge rail* for some years to come, I propose to allow edge rail of 40 lbs. and upwards per yard in weight, to be imported free of duty for 6 years, say up to the 4th of July, 1848, by which time I hope our establishments will have acquired sufficient extension, as well as capital and skill to undertake the manufacture of edge rails. To show what I mean by edge rails, I send you the enclosed sheet containing tracings of sections of the different patterns of rails in use in the United States and in Europe. But under this denomination I class all rails that are rolled and *are not flat bars*, whether they be after the T pattern, the L pattern, ⌶ pattern, or the bridge pattern, or any other pattern that ever has been rolled. My reason for restricting the minimum weight, to 40 lbs per yard, is that the heavier (within reasonable bounds) the rail, *the more perfect the railway will be.* Most of the railways in the Eastern States have iron weighing from fifty five to sixty five lbs. per yard, and the flat bar is going out of use wherever the parties are rich enough to replace it with the edge rail. The use of the flat bar is most inexpedient, and though less in the first cost of the railway, ends in being far more costly, as the expenses of repairs, cost of transportation, and danger of throwing the trains off the track, renders it in every point of view excessively inferior to the edge rail. In new and poor districts of country, the flat bars may be used until by establishing channels of trade, sufficient capital may be accumulated to justify the cost of replacing them with heavy edge rails. This has been done in several parts of the country already, and will become universal whenever railway concerns can bear the cost and inconvenience arising from a change. I might give many other reasons for keeping the duty off edge rails for a few years longer, but fearing to intrude too much on your time, I will only mention one other reason and that affects the interests of the American iron master himself. The principal expense of making iron in this country arises from transporting materials to the place of manufacture, and afterwards the manufactured article to market. For example, the iron stone and fuel (wood) are generally in the same neighborhood, but limestone and bog ore may be ten, fifteen, or twenty miles off. The furnace for smelting the ore into pigs is generally many miles distant from the forge, or rolling mill, for converting them into merchant iron. So, also the rolling and slitting mills for the manufacture of rails etc. are usually still more distant from the smelting furnace. Therefore

until all these establishments or the elements (the fuel, limestone and iron ore) for the manufacture of iron are concentrated, as they are in Wales, Staffordshire, Stropshire and other parts of England—and also in Scotland, the iron masters (and also the consumers) are interested to have the importation of Railway Iron continued free of duty. Besides the construction and use of railways calls for a very enlarged consumption of iron (every pound of which must be made by American iron masters,) in making locomotives, tenders, wheels, axles, spikes, screws and a great many other articles of iron which are to be furnished exclusively by the home producer.

I will not trespass more on your time, but conclude by reiterating the hope expressed above, viz.: that all edge rails of 40 pounds per yard and above that weight may continue to be imported free of duty for six years up to 4th July, 1848.

I am with great respect,

Your obedient servant,

GERARD RALSTON,

Of A. & G. Ralston, & Co.

P. S. The Liverpool and Manchester Railway began with rails 34 lbs. per yard, but through successive changes, going higher and higher, it now has rails of 70 lb. per yard. The heaviest iron used on any railway in England, is on the London and Brighton road which weighs 76 lbs per yard. On the Philadelphia and Columbia Railroad, the rail imported 10 years ago was only 41 1-2 lbs. per yard, but recent importations for this road weigh 56 lbs. per yard. So also on the Philadelphia and Reading Railway, the first rails did not exceed 42 lb. per yard, but the recent importations weigh 55 lbs. per pard, and this must give place in a few years for rails of 70 to 75 to accommodate the heavy trade in coal and iron on that road. If a duty edge rails be imposed, the importation will cease altogether, or the rail will be rolled lighter and lighter instead of as experience has taught they should be, heavier and heavier than they have been.

G. R.

For the American Railroad Journal and Mechanics' Magazine.]

WORKING OF ENGLISH RAILWAYS.

We have much pleasure in presenting our readers with the following specimens of the working of English railways, as affording means for useful comparison with those of our own country. They have been compiled from Herapath's Railway Magazine of 13th August, 1842.

The "London and Birmingham" Railway is the great Levia-

than as a road for travel, as the "Stocklin and Darlington" is for the passage of tonnage. On the former, for the week ending 6th July, the total receipts were 103,360. At the present quotation of £180 for 100 of this stock, the value of these 113 miles of double track railway, is equal to the enormous sum of $53,100,000. It will be observed that the ratio of expenditures to the gross receipts have been reduced in the last returns to 25 1-4 per cent. and that as a consequence of the increasing magnitude of their business, still further economy is expected.

If our post office department is at any further loss as to what is paid in England, under this head, they can be referred to

The "London and Birmingham" which receives at the rate of $637 per mile per annum, for 113 miles.

The "Birmingham and Derby Junction," which receives at the rate of $554 per mile per annum for 48 miles.

The highest rate fixed by law of Congress of the United States is $300 per mile, per annum; a rate even, much complained of by the Department, and the necessities of our railways have been used by it to obtain much lower rates, in many cases not affording a just remuneration for the services performed. Taking into view the immense mass of circulation in this country of newspapers, pamphlets, etc., the size and weight mailed by railway in either country, is not materially different, as we have been assured by parties who have looked into the subject.

Our best American Railways are worked quite as cheaply as those in England, but unable generally to make as good a show of business, are not as yet in as good credit. In both countries the improvement is still progressive.

London and Birmingham Railway, opened throughout in 1839.

Capital stock,	18,400,000	
Loans,	9,730,000	
Locomotives,	647,000	
Carriages and wagons,	744,000	
Total cost for 113 miles double track, or per mile, $261,200	$29,521,000	
[Receipts for six months, ending 30th June, 1842.		
From Passengers,	$1,324,000	
" Mail, equal to $637 per mile per an.	36,000	
" Merchandize, parcels, cattle, etc.	582,000	1,942,000

Disbursements for same period.

Maintenance of Way.

Repairs to permanent way, per contract for 6 months,	96,000		
Repairs to bridges, fences, drains, turn tables, engines, and other salaries,	16,000	112,000	1,042,800

Locomotive Power.

Wages to enginemen and firemen,	24,000		
Coke fuel,	71,000		
Repairs to engines and tenders, equal to 5 3-4 per cent on cost,	36,000		
Laborers, cleaners, oil, stationary power,	39,000		
Salaries of superintendent, clerks, etc.	15,600	185,600	

Transportation Account.

Wages to policemen, coach guards, &c., gratuities to switchmen,	66,800		
Salaries to various clerks,	14,600		
Salaries of Secretary, office rent, travelling expenses, etc.	32,000		
Repairs to carriages and wagons equal to 6 1-2 per cent on cost	48,800		
Compensation for damages, oil, signals, clothing, etc.	10,400		
Gas at stations,	5,300		
Carriage and wagon grease, stationary waste, etc.	12,200	190,100	
		487,900	

Charges Extraordinary.

Mileage duty to government, 4 3-4 per cent on receipts from passengers,	106,400		
Parish rates	43,600		
Reserved fund for depreciation of locomotive and carriage stock,	71,600	221,600	709,500
			$1,232,500

Interest Account.

Interest on loans for six months,	255,500

Dividend Account.

Half yearly dividend declared on capital of 5 per cent,	$977,000

Remarks of the Chairman from the Report.

"The increase of nett profit for these six months, as compared with the corresponding half year of 1841 will be found to be $128,700.

And the most pleasing feature of this increase is, that it chiefly results from a progressive decrease in the charges on the company revenue, and particularly in that portion, which immediately attaches to the working of the traffic, and which, as appears from the June half yearly statement has been successively reduced from 34 3-4 per cent, to 29 1-2 per cent, and lastly to 25 1-4 per cent on gross receipts.

"In travelling this year from John o' Groats to the Lands End, I heard nothing but commendations, nothing but uniform praise of the London and Birmingham. Long may we continue to go on in this progressive state."

Birmingham and Derby Junction Railway, opened throughout in 1842.

Capital stock	$3,903,000
Loans,	1,268,000
Locomotives,	166,500
Carriages and Wagons,	230,000
Total cost of 48 miles of double track $116,000 per mile,	$5,567,500

Receipts for six months, ending June 30th, 1842.

From Passengers,		83,400	
" Mail, equal to $554 per mile, per annum,		13,300	
" Merchandize, parcels, cattle, etc.		51,900	148,600

Disbursements for same period.

Maintenance of Way.

Per contract for 6 months,	18,800	

Locomotive Power.

Wages and salaries,	8,800	
Fuel, coke,	10,400	
Repairs of engines, etc. eqnal to 6 per cent on cost,	9,500	28,700

Transportation Account.

Salaries and wages,	17,000	
Depairs to coaches and wagons, equal to 3 1-4 per cent on cost,	7,300	
Advertising, insurance, damages, clothing, travelling expenses, etc.		

Toll to London and Birmingham Railway,	5,700	37,200	
		84,700	
Charges Extraordinary.			
Mileage duty, rates and taxes,		8,700	93,400
			$55,200

Remarks of the Chairman from the Report.

"This line has been in full operation for only a few months, and both the business from merchandize and travel continues to improve as well by the increase of the original, as by the addition of new branches of trade.

Reductions in working the line are also progressive—the [most important being in that for maintenance of way—the average contracts hitherto having been at $900 per mile, but which have now been taken at $585 per mile, including sleepers and all materials except rails."

Northern and Eastern Railway, opened throughout in 1842.

Capital Stock,	$4,135,000
Locomotives, Carriages and Wagons,	237,000
Total cost of 29 miles double track, $150,000 per mile,	$4,372,000

Receipts for six months, ending 30th June, 1842.

From Passengers,		142,800	
" Parcels,		2,200	145,000
Disbursements for same period.			
Maintenance of Way.			
For six months, per contract,		5,700	
Locomotive Power.			
Salaries and wages,	13,900		
Fuel, Coke, etc.	13,900		
Repairs to engines,	1,300	29,100	
Transportation Account.			
Wages to conductors, guards, etc.	9,700		
Salaries, stationary, printing, etc.	7,600		
Repairs to coaches,	2,500		
Toll to Eastern counties railway,	13,700	33,500	
		68,300	
Charges Extraordinary.			
Mileage duty,	7,300		
Rates and Taxes,	2,200	9,500	77,800
			$67,200

Remarks of the Chairman from the Report.

"This line has been open throughout but eleven weeks, and from the result we may anticipate a period of prosperity. The expenses thus early of working this line have been only about 41 per cent, which is a gratifying circumstance, because it is allowed that on an average receipt of $7,500 per week, the average expenses should be $2,500, or about 33 per cent.

I consider that we shall very soon have a goods traffic, and while at present we fire every day seven engines, I think with the same extent of power, we might carry goods affording an increased recept of $1500 to 2000 per week without any additional expense."

REPORT OF THE SOUTH CAROLINA CANAL AND RAILROAD COMPANY,

To the Stockholders of the South Carolina Canal and Railroad Company:

In accordance with the general usage of this company, a statement of its affairs are herewith presented, showing the business, and receipts, and expenditures for the six months, ending 31st. December, 1841; by which it appears the gross income has been $163,748 83

And the expenditure for repairs and improvements. 119,675 89

Leaving a nett income of $44,072 94

Nearly the rate of 4½ per cent. per annum—

Showing a gain over the corresponding months of the year previous, of $11,517 13

Viz.: in increased receipts, 3,849 80

And in less expenditures, 7,667 33

The most remarkable saving in the ordinary expenses, is in the article of oil—and has been produced by the use of palm oil and tallow, instead of limpid oils.

The cost in the last year of this item, has been less than the average of the five preceding years, $3,234 93

The average cost of oil and tallow for 1836, '37, '38, '39 and '40, per year, is 5,769 90

And for 1841 only, 2,534 97

The saving in wood for fuel, in each of the last two years, has been greater than that of oil for the last year, though not so much in proportion to the whole amount used.

The average cost of wood, for the years 1836, '37, '38 and '39, was, per year, $15,253 83

In 1840, $10,957 54, saving 4,296 29

" 1841, 9,949 29, " 5,304 54

As the cost of these items have been reduced without any great decline in the price of either, it will be proper to explain how the result has been effected.

After several years trial of palm oil, with good effect, the hardest tallow has been substituted for oil, on all the journals where boxes are fitted to receive it—Boxes are required under the journals as well as over them, and both must be crowded full of firm tallow, so as to exclude the air.

The rust of the iron incorporates with the tallow, and forms a preparation equal to plumbago, in which the journals literally float, and prevents any contract of the metals—consequently no heat is produced, no wear of the journal of steel, or the *bearing* of chilled cast-iron, and scarcely any consumption of the tallow, where the boxes and bearings are properly fitted.

The chilled bearings must be cast at least 1-8th of an inch larger in diameter, than the journal, to admit the tallow between them on the sides of the latter.

When the frames of all our cars and engines are fitted with *chills* and bottom cups or boxes, there will be a further saving. The change of steel for iron journals, and cast iron chilled bearings for brass, is made as fast as practicable, and has been in progress over three years. In proof of what we have stated above, the following fact is presented.

On the 16th, 17th and 18th of July last, the boxes of all the cars in the passenger trains, say ten cars on 8 wheels,—were supplied with tallow in the manner above stated, requiring about three fourths of a pound to each journal, or in all sixty pounds—and they are now all in the same order—though not more than half the same quantity has since been added, say thirty pounds, or ninety pounds in all for six months; each having performed about the average run of one hundred miles per day, for the whole time, without the least perceptible wear of either journal or bearing. The same can be said in the use of palm oil, for over three years past; but the expense of the oil is much greater than the tallow.

The saving in the cost of wood, for fuel, has been in contracting for it, cut in lengths proper for use, and corded by men in the employ of the company: thus obtaining better measure—and the increased speed of the trains, keep them out a less time, and a less quantity is supplied to the furnace; it having been found that the practice of filling the furnace with wood, did not answer so well as feeding more lightly, making a freer fire, and consequently a less consumption of fuel. One thousand dollars of the cost of wood in the last year, has been saved by the application of locomotive power for stationary, at the Plane.

The timber account, for the last two years, has been reduced each year, about ten thousand dollars below the cost of previous years—as less has been required, since the road has been so much improved by a firm embankment, and new iron.

It is believed, however, that a greater reduction in the cost of this article is to be obtained by mineralizing it with a preparation

recommended by Doctor Edward Earle, of Philadelphia, and mentioned in our last report—called *Earlizing*. If the expense does not exceed his calculation, say 2 and a half to 3 cents per cubic foot, or if even four cents, the timber may be put into the road at no increase on the present cost; as an inferior timber of small trees, embracing the sap, as well as the hearts of the wood, would answer equally well, and be obtained at a price, which with the preparation, would not exceed the present cost of heart timber; and if the durability is only doubled, the saving in material and labor, would be fully $30,000 per year.

It is believed that timber made of pine saplings, would receive the mineral better, and be equally serviceable, and as durable as the timber entirely from the heart of the tree; so, with any confidence in this process, it would be criminal to neglect it—especially as a test has been made in the wooden pavements of Philadelphia, which have been in use two years and a half, and a recent examination, reports the timber, Earlized in these pavements, perfectly sound, while that unprepared of the same kind of timber, (Hemlock) is quite rotten.

We have commenced this process, in a small way, in timber to be used for revolving sections, and turn out gates, etc., the durability of which is of more importancce than the main track, and in such places can be better kept in view, as an experiment.

After better ascertaining the actual expense, it is hoped that it will warrant a continuance of the work, till the whole road is renewed with mineralized timber.

The machinery account has been greatly reduced; (except $7,333 worth of chilled wheels and axles,) the account for the last twelve months is very small, not half the average of former years. The machinery that was formerly charged, is now produced in the workshops of old materials as well as new—by this the workshop wages are gradually increased, although not in proportion to the reduction in the amount of machinery—having the satisfaction of making, in our own shops, with our own men, nearly every article of machinery which we formerly imported.

The Master of Machinery has been very successful in casting chilled wheels—has about thirty pair made, and some of which have been in use long enough to prove them equal to any that have been ordered from other works. Having arrived at this fact, we shall go on with confidence, and endeavor to supply ourselves with new wheels as fast as they may be required, for the future.

The company is much indebted to the aid of such of the officers and men, who are exerting themselves to reduce the expenses in every department—and it must be a great satisfaction to those, who are thus engaged, to reflect, that they are saving to the company, more in this way, than double the pay they receive for their services—and although the business of the road does not yet yield an adequate return to the stockholders, for their investments, it is believed that with a steady perseverance in the economy of its affairs, it will soon do so.

The interest, on the amounts borrowed, from time to time, from the Louisville, Cincinnati and Charleston Railroad Company, to complete the improvements of this road, amounting to $37,869 70, has been lately calculated, and placed to the credit of that company and charged to construction and outfit. It is expected the present year will enable this company to pay this, as well as the balance of principal due, amounting in all to $57,388 56, after which, the nett income will be paid over in dividends, instead of the liquidation of debt.

The larger receipts of 1839 and 1840, over other years, as shown in comparative statement (D) is accounted for, by the higher rate of tolls in those two years.

We also present a paper, showing the cost of each item of expenditure, for each half year, from 1835 to date. The summing up of which, will show a gradual decrease in the total expenditure for the last five half years—and for the last year, $132,000 below the average of 1837, '38, and '39, being about $376,000
And that of the year 1841, 244,000

This calculation does not embrace the amount paid for embankment, rail iron, or land, but includes all other improvements now covered by current expenses. It is proper to state, however, that in the three years mentioned above, the railroad was literally rebuilt.

A further reduction of the expenses is expected, provided there is no increase of business to prevent it, which would be more desirable. The proposed reductions are in the timber, by mineralizing it—and in the machinery, by making all at home, instead of importing it, to which we are fast approaching.

The difficulty of apportioning the machinery, to an uncertain amount of business to be done, with a liability of having a superabundance of power, and consequently, a waste of capital, must be apparent to all who have considered the subject. This is explained in a correspondence with Col. Gadsden, President of the L. C. and C. R. R. Company, and is as follows:

Office of the L. C. and C. R. R. Company.
Charleston, October 23, 1841.

To T. Tupper, Esq., President, &c.

Dear Sir:—I have been under the impression, that the motive power, burden and passenger cars, belonging to the S. C. C. and R. R. Company, with the ability of the work and carpenter's shops, to keep them in repairs, and to increase them if necesary, would be, or could be made equal to the business and travel on that road, as well as on the L. C. and C. R. Road. As the latter progresses, and new sections are opened, increased facilities for transportation will be required, and pursuing the plan which has been adopted, of devolving on the S. C. C. and R. R. Company, the furnishing of the power, and the managing of the transportation on the road to Columbia, from Branchville, it becomes necessary to ascertain from you, whether there will be any difficulty in the accomplishment of

this object, so that the subject may be submitted, if necessary, to the Board, and provision be made accordingly. I am more than ever satisfied, that after the road crosses the Congaree, and a depot is opened on the north of that river, that the freight business, even this season, will be considerably enhanced; and the progress of the road, and its near approach to Columbia, even if not completed to that point, will devolve on us all the spring travel and transportation of that city. It is important, therefore, that arrangements be made in advance, so that our roads be found fully equal to all that may be offered. Respectfully,

Your obedient servant,

JAMES GADSDEN, *President.*

Office of the S. C. and C. R. R. Company.
Charleston, October 28, 1841.

To Col. JAMES GADSDEN, President.

Dear Sir.—On my return from the country, Monday, the 25th inst., I met your favor of 23, making inquiry respecting the ability of this company to do all the transportation on this road, and on the L. C. and C. Railroad, as the latter progresses, and new sections are opened, increased facilities would be required, etc. I have felt much anxiety on this subject, for months past, as in former years, when the time approaches for the winter business; not for want of ability to provide power, but the difficulty of proportioning the supply to the uncertain demand for it. Last fall the power was more than required all the season. The year before, was deficient with press of business for one month only, when the income from that month was over $65,000, and thirteen engines only were employed in all that month. Now, as the business of that month was much greater than any, before or since, and about double that of ordinary business months, it might be supposed, an equal provision of power would be sufficient for the business of the present winter. But instead of thirteen engines, the number used in November 1839, Mr. Ross informs me, he has in running order, fifteen engines, and three that will be out in about three weeks, and three more in February next, and three others rebuilding, probably in all next year.

With the cars now in order, and those that are finishing daily, we hope to be able to perform, as much as has been done, in any former season—and probably more should the business increase, as we hope it will.

I have sometime past requested Mr. Ross and Mr. Hacker, to employ all the hands they could to advantage, in our own shops, and procure the aid of other establishments, if necessary, to keep on the road, all the machinery, that might be required. We are casting and importing wheels and mounting cars, as fast as the wheels are ready, so that should the produce press upon us at any time, by suspending the transportation of materials for the L. C.

and C. R. R. Company, for a little time, I have no doubt, we may be able to keep the stations clear of cotton, or nearly so.

Very respectfully,
Your obedient servant,
T. TUPPER, *President.*

The connexion between the L. C. and C. R. R. Company and this, will be better understood, by reference to a letter from Col. Gadsden, the President of that company, with the reply, which are annexed, turning over to the officers of this road the Columbia branch as fast as completed and received from the contractors for transportation and repairs, of which a strict account is to be kept, and that company charged and credited, as the case may be.

Extract from a letter of the President of the L. C. and C. R. R. Company, to the President of the S. C. C. and R. R. Company, and dated 24th November, 1841.

"By a resolution of the Direction of this company, the preservation of the track, and the furnishing the necessary motive power, burden and passenger cars, etc., together with the direction and management of the transportation on the sections of the road, between Branchville and Columbia, has for the present, been devolved on the officers of the S. C. C. and R. R. Company. You will be good enough, therefore; to assume the duties, and give the necessary instruction for carrying the same into effect. As previously advised, the road has been opened for freight and passage as far as Lewisville. As the contractors are bound to keep that portion between Orangeburg and Lewisville in repair, for three months from the 5th of October last, your attention will for the present, only have to be directed to Orangeburg."

Extract of a letter dated on the 29th Nov. 1841, *from the President of the S. C. C. & R. R. Company, to the President of the L. C. & C. R. R. Company, in reply to the foregoing extract.*

"Your letter of the 24th inst., duly received, turning over to the officers of this company the keeping up, and the transportation upon the Columbia branch road, so far as opened and received from the contractors. I have extended the order in conformity, and will do all in my power, to comply with the wishes of the L. C. and C. R. R. C., in the extra duties required of me, in common with those on the main stem of our road to Hamburg."

It is about time that those interested in these companies, should look to see on what ground they are standing, to know the value of the respective charters—to preserve that which is good, and reject that which is worthless. That the business of the two companies may be so arranged as to be conducted by one board and one set of officers, as required by the stochholders of that company at its last meeting.

Having by authority of the board, attended a meeting of delegates, from the several railroads in the United States, by invitation of the Post Master General, on the 1st. of January, 1842, at Wash-

ington, where they received a communication from that officer, respecting the difficulty of regulating the mail connexions at different points—not having the power to control the hours of arrival and departure of the cars on the several railroads.

A committee of six was appointed to reply, in behalf of the convention, to this communication, and the following members appointed on the committee—Louis McLane, of Maryland, Chairman; Dr. Shepherd, of Virginia; Gov. Dudley, of North Carolina; J. P King, of Georgia; R. L. Stevens, of New York, and George Bliss, of Massachusetts.

It was proposed, that the members of the convention, send to the chairman, any facts they might deem proper, to be in the reply, to be used or not by the committee.—The following is the communication by this company:

Office of the S. C. C. & R. R. Company.
Charleston, January 8, 1442.

My Dear Sir,—Enclosed, are some facts connected with our establishment, which will show how much we are disposed to take advantage of the department, or on the contrary, how much we have suffered by our connexion with it. I am sorry to say my experience teaches me, that any thing given to the public is seldom acknowedged, and only increases the demand for something further.

With full recollection of the last clause of the resolution, which induces this communication, (the right to reject it)

I am, with great respect,
Your obedient servant,
T. Tupper.

To the Hon. Louis McLane,
Chairman Committee R. R. Committee.
Baltimore, Md.

Office of the S. C. C. & R. R. Company.
Route 2214.

Before the great mail was conveyed upon this route, a six days service, per week, in winter, and three days service in summer, with a speed of 10 to 12 miles an hour, was only required. Then freight could be taken with the mail and passengers, exceeding in amount tour times that now received for the mail, which cannot now be done and performed in contract time.

By such an arrangement, particularly in summer, a freight train could be saved, and all the year the Sunday service avoided; the cost of which approaching nearly one seventh part of the whole expense of the company, say $240,000 making $34, 285, or at least the full amount received for transporting the mail, $27,600.

The facilities given to business, by the establishment of railroads, letters and papers have been much increased—say three fold, since the contracts were first made, and no additional pay to the compa-

nies, when, if continued in stage coaches, a correspondingly increased pay would have been incurred.

On this road, an engine at ten miles an hour, would carry freight with the mail and passengers, amounting to at least *one hundred and fifty dollars* each way, and frequently double this sum westward—when the same engine, with the mail at twenty miles an hour, now required, conveys no freight, and only receives each way, *thirty seven dollars* for the mail, a clear loss of *one hundred and thirteen dollars* per trip, or, *two hundred and twenty six dollars* per day—Making in a year, a certain loss of *eighty one thousand three hundred and ninety dollars*, by the speed necessary to carry the mail in contract time.

In the event of a war, this company will be found ready to make further sacrifices, to serve our country, and for a moderate pay transport men and munitions of war, in preference of all other business.

By order of the Board,

TRISTRAM TUPPER, *President.*

Charleston, Jan. 8, 1842.

REPORT OF THE SOUTH CAROLINA CANAL AND RAILROAD COMPANY, FOR JULY, 1842.

To the Stockholders of the South Carolina Canal and Rail Road Company:

In conformity with a rule of this company, and the general usage, we herewith present the semi-annual accounts of the Secretary and Treasurer, from the 1st January to the 30th June, 1842, both included; showing the whole income, for these six months to be $167,156 39

And the expenditure for the same time, 115,657 40

$51,498 99

Being over the rate of 5 per cent. on the capital of $2,000,000, and $17,250 42 more than the nett income of the first half of last year—

By increased receipts, $8,164 27

And by decreased expenditure, 6,086 15

Had the improvements in the road, machinery, and buildings, with the increased amount of materials on hand, in the last three years, been paid for by the increase of capital, as is the practice of other companies wishing to make a good showing, the nett income of each half year would have been fifteen to twenty thousand dollars more than has been represented by our accounts, as it is, the property of the company has been improved and should have a relative increased value to the stockholders, as in this way, the nominal capital is less than the actual amount invested in it. For the ensuing half-year, the expenditure may be much reduced from the last, if the business should not be much increased, as the

improved state of the road and other property of the company, with the ability of the shops to turn out any new work that may be required, a less outlay will be called for. The *machinery* is now in better order than ever before, as will appear by the return of the Master of Machinery. There are seventeen engines and tenders, in good order, and seven others building, re-building or repairing. These, with the cars, many of which have been supplied with wheels from our own shops, will be equal to transporting a larger amount of goods and produce than on any previous year.

The wheels that have been cast in the foundery of the company, in the last twelve months, and have been fairly tried under the engines, tenders, freight and passage cart, in all about one hundred pair, have proved better than any before used on the road, and are substituted for the cast iron wheels with wrought iron tire. These cast iron wheels with the steeled journals and chilled iron boxes, all made in our shops, will result in a saving of eight or ten thousand dollars per year. *Tallow* in the place of oil is also working well. Nearly all the journals are supplied with it, and in all the year the advantage of the change will be further seen, as a small quantity will be required to replenish the boxes when once filled.

In the road department, some progress has been made in the preparation of timber, with the sulphate of iron and copper, as will be seen by the report of the superintendant of the road. About 100,000 lineal feet of rail timber have been contracted for at 2 1-2 cents per foot, being about half the average price usually paid. About 50,000 feet have been delivered, and 12,000 feet have undergone the process of Earlizing in tanks prepared at the 58th mile, and 5,000 feet have been put in the road, 2,000 of which was used to renew the turnout on the 8th mile about the middle of April last. This timber is obtained at a reduced price, as the sap is embraced in the square of the piece and consequently taking a much less tree than when the heart only is retained.

The advantage of this process will be felt at once in the lower price at which the timber is contracted for, and should it only last as long as ordinary timber, no expense will have been incurred, as the difference in the price of the timber will pay the expense of preparation.

The timber prepared four years ago with corrosive sublimate, is still sound, the sap of which has already shown a durability of double that of unprepared wood, and, from all appearance, will be sound when the unprepared is so rotten that it cannot be separated from the earth in which it is buried.

The state of the land of the company, as far as there is any difficulty connected with it, is explained by Capt. Robertson, Land Agent, in his report marked (3.) There are some points in this, that require attention. This report will give the company some idea of the importance of the office, and enable them to determine whether it shall be continued or not—at any rate, it would seem, that as the whole of the year cannot be employed, the pay might be reduced, if the office is not abolished.

An increase in the cost of wood for fuel will be perceived over that of the last year. This is produced by the increased trips on the Columbia road, and the higher price paid for it on that line. The cost of the wood for that branch will be more than one third of the whole, from the fact stated above. Deducting that used on the branch, would exhibit a further reduction in the cost for the main stem of the road than that shown in our last report.

The wages of negroes will be further reduced, and will be more felt in the next year's account; already, however, some are hired at from nine to ten dollars, giving rations only, and deducting sick runaway time, as in all former contracts.

The arrangements for business are now so complete, that if no farther movement is made in the reduction of rates, the current half year will, no doubt, on both roads, furnish a nett income of not far from $100,000.

The number of passengers that have passed on the main stem of our road the last six months, are only 20 per cent. less than in the corresponding months of the year 1839, but at the higher rate then charged, our receipts were $107,933 against $65,866 this year—over 6 per cent.

The Columbia branch road having been extended to Columbia, though not quite completed, was opened for passengers and freight on the first of July instant.

The transportation upon, and the keeping in repair, of that road, as fast as turned over by the contractors, was assigned to the officers of this company by the order of Col. Gadsden, President of the L. C & C. R. R. Company, in November last, and these duties have been attended to by Mr. Lythgoe and myself, in common with the same duties on the main road. It is now found, that the expenses of both roads have not exceeded $125, 000 for the last six months, being the lowest amount ever suggested by the most rigid economist, and if there be no increase of business to demand a great outlay, can be further reduced after the Columbia road is fully in order, now made otherwise by the washing and sinking of the embankment and the giving way of some of the culverts, caused by heavy rains.

The superintendant has taken the floating gang from this road, and hired others, in all about forty hands, to make these repairs, and when done, if no further effects of storms, the force can be much reduced. The police of that road is not fully organized, but will be so, as soon as all parts of it are turned over by the track-layers.

It is believed, that no increased power or cars will be required to do the business on that road, as the transportation of the iron and timber, while building, was equal to the ordinary traffic which will be offered on it when the road is in full operation. To provide, however, for a press of cotton in the fall, eighteen platform cars are building, which, with twelve of the same already made, will make three trains that will carry 500 bales each. These alone would take to market more than has ever before been brought in, for any extent of time, from all points on the Hamburg line.

The receipts of the Columbia road, for the six months, ending 30th June, were,

For Freight and Passengers,	$12,050 98
The expenses charged,	7,520 43
Nett receipts,	$4,530 55

The average distance passed over in the six months was about forty miles. But as passengers are now landed in Columbia in about eight hours from Charleston, and the freight in about twelve hours, it is believed that a large proportion of the business heretofore carried through other channels, will now be diverted to the railroad.

Respectfully submitted.

T. Tupper, *President.*

Charleston, July 20th, 1842.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING.

Lecture 10.—*On the upper works of railways.*—This lecture was on the upper works of railways, which term, the Professor stated, was intended to comprehend everything above the bed or formation level of the roadway—viz., the gravel, broken stone, or other road material, technically called the "ballasting;" the stone blocks or wooden cross sleepers, laid thereon; the chairs and rails, and their fastenings, as attached to the stone or timber supports; and the boxing or filling up of the road material around these supports, when the railway is finally laid to the proper gauge, range, and level—the whole of the materials and adjustment forming the "upper works"—an expression borrowed from the German *oberwerke.* The depth from the road-bed to the level of the rails, of all these parts, as permanently laid together, is seldom less than two feet, when a good way is to be insured; the principle to be observed being to have the ballasting of such a material and nature that water will percolate freely through, as clean gravel, cinders, quarry rubbish, coarse sand, etc. The word "ballast" is a northern provincial term. Some of the first railways were introduced into the vicinity of Newcastle-upon-Tyne, Shields, and the neighboring coal shipping ports, and in being found necessary to have a bed or layer of some material, to receive the railway track, the same not to be retentive of water, the gravel brought by the colliers from London as ballast, and accumulated in hills or spoil-banks near the side of the harbours, was found to answer the purpose very well; the expression has since become common for whatever other material was similarly used for laying railroads. Mr. Vignoles observed that a great number of other technical words now in common use, when treating on railway works, were provincial terms, chiefly from the north of England. When the bottom of cuttings, or top of embankments, are of soft material, it was recommended to make a

kind of pavement or hard layer, on the forming level, below the ballast. On embankments, until the became well consolidated, this pavement would not perhaps he conveniently put in; still means should be contrived to carry off the water quickly from the surface and the Professor insisted much on the free introduction of blind, or French drains, of brokon stone, among or under the ballast, connected with the open side drains, which should never be omitted in cuttings; on embankments these cross rubble drains should go free of the road-bed, with water channels down the slopes, of sods, or more substantially formed if needful.

The bed of the railway having been prepared on the above principles, next came the consideration of the railway itself. The substance first used for this trackway was wood, and afterwards a metal rail, plated on the wood; after 200 years' trial of different systems—for so long was it since the first colliery wagon-ways were introduced—the Professor observed, we are just coming back to the original form and material as best adapted for the purposes of a railway—viz., timber laid longitudinally. When blocks of stone are used to support the chair and rail, weight seems to be sought for as desirable, and the general cubic contents of such blocks as are considered proper for a good way are about five cubic feet—viz., 27 inches wide, and a foot thick. When cross bearers of wood are the supports, each sleeper, as it is termed, contains about two cubic feet of timber, being about seven feet long, with a transverse section of 40 square inches, being full eight inches broad and averaging five inches thick. The intervals at which the blocks or sleepers are placed vary from three to five feet, according to the weight of the rail or of the load. With these descriptions of supports becomes generally necessary that a chair or saddle be attached thereto to receive the rail, which is seldom fastened directly either on block or sleeper, without the intervention of this contrivance of a chair, unless when the rail is made wide and flat at the base. Such shaped rail is now much used on cross bearers of wood for temporary railways, by contractors, while executing works. Mr. Vignoles said this form of wrought iron rail was first introduced nearly 12 years since on the St. Helen's Railway, by some contractors, at his suggestion, and the same rails were lately in use by the same persons, and still good and serviceable, after continued use. Of late it had been recommended by many engineers—among which Mr. Vignoles believed he was among the first—to lay down the railway bars on bearings of timber, disposed lengthways in the direction of the way, and upon which the iron had a continuous bearing, instead of having it supported at intervals (either with or without chairs,) as was the case when blocks or cross timber bearings were used. In describing the different modes of laying rails, the Professor observed that the heavy stone blocks being packed around, or boxed up with ballast, kept the rails in place—that the cross sleepers having both rails attached thereto, the gauge or breadth was preserved; with the longitudinal system of bearings, the parallelism was retained by cross ties of wood, with tenons,

and sometimes by rods of iron with screw-ends and nuts, and occasionally with both. It was necessary thus to provide for preserving the breadth of the railway, for, as the carriages and engines work along the rails with a wriggling motion, there is always a tendency, by the lateral action of the flanges of the wheels, to push the road out of gauge. Mr. Vignoles mentioned the two new lines added on the south side of the London and Greenwith Railway as the latest examples of longitudinal timber bearings; but he observed that, as the great point in this system was to insure that the rail be firmly attached to the wood, to prevent any vertical play, he considered a more effectual method might have been there used, so as to have the iron continually united to the timber, on a plan which he had tried with success, and to which he would presently advert. When iron was first introduced for railways, it was for a long time merely a plating of metal on the edge of the wood rail, on which plan, with iron bars of greater or less weight, many of the lines in America had been laid. Cast iron being next introduced, the system of fastenings was necessarily changed, and the original longitudinal timbers abandoned for cross sleepers, or isolated stone blocks. The rails being cast in lengths of three or four feet, it was found expedient to prepare some contrivances to receive and fasten the ends together, and this was the saddle or chair. Some of these iron rails were cast deeper in the middle, and, from their shape, got to be termed "fish-bellied." this form being probably adopted with the idea of obtaining uniform strength; though, for railway purposes, the position of this increase depth was the reverse of that given to bearers intended to resist quiescent weights. From the action of the moving weight, however, upon rails with so many joints, they soon got out of order. Wrought iron was then introduced, to get greater lengths; the first of these were rolled at a considerable expense of useless ingenuity into the same form as the fish-bellied cast iron rails, the length of 15 to 18 feet being divided into five or six flat ellipses. On most of the lines where this description of rails was first laid, it has been found necessary to take them up, and replace them, as they were found to break at a short distauce from the points of support. Mr. Vignoles stated that he had, from the first, decidedly set his face against this form of rail, and argued for and introduced rails with the same section throughout their length—since commonly styled *parallel rails*, as distinguished from the "fish-bellied rail," adding 10 lb. to the original weight of 35 lb. to the yard, by putting on a lower rib or web, on the principle that gave such additional stiffness to all beams; this lower web was increased in size from time to time, until, in a special report to the London and Birmingham Railway, Mr. Vignoles recommended that the upper and lower webs, or buttons, should be made precisely alike, to allow the rail to be turned up or down, or in either direction. This form was, however, first actually laid down by him on the North Union Railway, and its advantages in the above respects have already been appreciated and applied: these rails are about 65 lb. to the yard. The Birmingham Company

decided finally on adopting this form, increasing the weight to 75 lb.; and, where chairs are used, it is now almost exclusively employed, the weight being sometimes increased to 78 or 80 lb. per yard. With the increase in the weight of the rail, the intervals between the supports also gradually increased from three to five feet, but with bad effect, as the expense of keeping a railway in order with the longer bearings (as the technical phrase is) was very much augmented; and, on the London and Birmingham Railway, intermediate supports had since been introduced, where the original bearings were five feet. Mr. Vignoles stated it as his opinion, deduced from considerable experience and observation, that where chairs and supports, at intervals, were used, he considered a 60 lb. rail, with a 3-feet bearing, better than a heavier rail with a longer bearing. Blocks, he observed, were, however, nearly exploded as supports; the cross sleepers and chairs were still preferred by many engineers, but it was certain that the closer the supports—that is, the shorter the bearings—the less the cost of maintenance, and hence the inference, which experience every where confirmed that the continuous supports were best of all. In respect of fastening the chair to the block or sleeper, and the rail to the chair, it was now almost universally admitted and acted upon, that compressed wood was much preferable to iron spikes, bolts or keys. Mr. Vignoles introduces a number of drawings, and described a variety of diagrams, illustrating the various shaped rails and chairs, and modes of fastening adopted, and drew comparisons as to the advantages and cost of each. In reference to what he had before stated of the disadvantageous method hitherto pursued in fastening rails with flat bases to continuous timber barings, by spikes or screws, the Professor said that such a mode seldom continued to hold the rail close down to the timber, and there ensued a certain quantity of vertical play of the rail on the wood, often accompanied with a good deal of rattling, and in the end, the head of the bolt or spike was absolutely jerked off. Mr. Vignoles said that the only effective fastening was that used with Evan's patent rails, which had a slit or grove of a dove-tail shape (in cross section) rolled for the whole length of the rail in the bottom; bolts, with similar-shaped heads to fit, were passed into this groove, and dropped at the necessary intervals, through holes in the longitudinal timbers; the bolt termined in a screw, and a washer and nut being put on, by means of a spanner, the nut drew down the rail closely to the timber. Mr. Vignoles stated that he had had a considerable length of railway thus laid, which had been done some time, and the rail had remained close down at the wood without any play, or getting at all loose. He concluded this lecture by stating that in the next he would endeavor to draw a comparison between the modern heavy rail and chair and fastening, as used with cross timbers laid at internals, and the rail and fastening as above described, to be laid on longitudinal timbers, and having a continuous bearing thereon.

Lecture 11.—In resuming the subject of the Upper Works of Railways, the Professor said he would enter briefly into the consideration of the strongest form of rail, after explaining those points

applicable alike to cast and wrought iron bars. First, a certain breadth was required for the bearing surface of the rail, for the wheel to run upon, and this breadth should be such as not to be likely to produce improper action or grooving, in the tire or tread of the wheel, and, at the same time, not to be increased so as to make the rail needlessly heavy; there must also be a sufficient depth or thickness of that bearing surface, to make it strong enough to withstand abrasion, and render the rail sufficiently stiff, and capable fully of sustaining the action of the driving-wheels of the locomotive engine. Hitherto the established breadth seemed to have been about two and a half inches on the top web, or button, and Mr. Vignoles thought, from experience, that that breadth should be considered the *minimum;* however, the strength of this bearing part of the rail, being as the breadth and square of the depth, a greater breadth than absolutely necessary to prevent the tire of the wheels being grooved, would add to the weight of the rail, without increasing the strength more than in the direct ratio of the breadth whilst the same quantity of material, disposed in terms of the depth increases the strength in the duplicate ratio. Considering the great increase of weight in the locomotive engine of late years, and the continued wear and tear on the rail, from the action of the driving-wheels, and looking to the state of the iron of the upper works of those railways which have not very heavy bearing surfaces, it would seem that, while two and a half inches is a *minimum* of breadth, the chief attention is now required to the proper depth, to resist abrasion and exfoliation which takes place, especially if the iron is not perfectly well rolled. Railway bars are compounded of fagotted iron, and if the pieces are not properly welded the bearing edge is broken down, and peels off; but, supposing the iron good, and the manufacture perfect, the heavy effects of the engine must be provided against, and experience shows that an inch and a half is not too much for the depth of the top web, or bearing part of the rail, and two and a half inches being the breadth, then three and three-quarters—or, say four square inches—should constitute the sectional area of the part that is exposed in receiving the direct action of the driving-wheels; this is the section actually requisite, and the greatest additional strength being to be obtained by increasing the depth, if possible, this is the point to be attended to. It thus appears that a weight of 36 lb. per yard is required to sustain the engine, and all beyond will belong to the mode of attaching the rail to the support below.

In treating of the wear and tear of rails. Mr. Nicholas Wood has given some curious and interesting results of experience: but the weight of the locomotive engines used is stated to have been only 10 tons, and of this the weight on the driving-wheels would probably not exceed six or seven tons. The result of a variety of experiments on the malleable iron rails of the Stockton and Darlington Railway gave one-tenth of a pound per yard as the absolute amount of fair abrasion; some statements, however, made it much higher, being one-sixth of a pound. On the Killingworth

Colliery it was one-eighth of a pound. On the Liverpool and Manchester Railway, some years ago, three rails were taken up, carefully cleaned and weighed, relaid, and taken up again at the end of one, and again at the end of two years: the wear was found constant, and about one-tenth of a pound per yard per annum. If we were to take this to be the true wear, and suppose it to arise wholly on the upper surface of the rail, the result would be but the 84th part of an inch in depth, and it might be supposed to take 100 years to wear away a rail from more abrasion. But later experience shows that the increased weight of engines acts very destructively on rails whose upper webs are not sufficiently strong, and of the best manufacture. We may take 10 tons as the present average weight on the driving-wheels of a locomotive engine; and, if this is to be effectually provided for, the button, or bearing part of the rail, must not be less than 40 lb. to the yard. Now the form of the remaining part of the rail will depend upon the manner in which it is to be fastened down to the support below, either by being fixed in a chair, which is itself to be again fastened to something else, or by being screwed down, as the rails on the Great Western, Croydon, and the new part of the Greenwich railway; or, finally, secured in the simple manner described in the last lecture. A comparatively very small addition to the theoretical form of rail to be sustained in a chair, gives a section which has the advantage of being capable of being turned in either direction, or vertical position, and hence the top and bottom of the rails have, of late, as previously stated, been made equal and similar, connected by a neck of proportionate dimensions. With the present heavy rails, of nearly 80 lb. to the yard, the average weight of the chairs, including the joint chairs, may be taken at 20 lb. per yard, reducing the intervals of support to that constant distance. Thus, we have an aggregate of nearly 100 lb. weight of iron per yard of each single rail. If, then, we could in any way get rid of the extra weight required to fasten the rail into the chair, and dispense with the chair altogether, it seemed to Mr. Vignoles to be desirable to do so, provided the object in view was equally well attained; and he contended that such would be the case with a 50 lb. rail attached, in the mode before described, to a longitudinal bearing of timber; for the whole strength of the upper or bearing part would be retained, that being as the breadth and the square of the depth; thus, with a weight of iron just one-half, would be equally efficacious, and it only remained to compare the supports in either case. Now, as stone blocks seemed to be discarded by universal consent, the question of the supports below is narrowed to that of *transvers* or of *longitudinal* wood sleepers. Sufficient experience had been obtained to warrant the conclusion that, for the purposes of this argument, the cost of fastening and of laying the rails, ballasting, drains, etc., taken as a whole, were nearly the same for both systems, and it only remained to contrast the quantities of timber, and always considering a locomotive line to be the one to be made, it may be stated that this cubing was about double for the longitudi-

nal system to that in the transverse method of laying the sleepers. In short, looking at first cost only, there was a saving of 100 lb. of iron, and an increase of two cubic feet of timber in each yard of single trackway of the former over the latter mode, so that strictly the longitudinal system was the cheapest; but to avoid minor objections, let the cost of each be taken to be the same, which was given a decided concession in favor of the transverse system. But this was a very narrow view to take of the question, which wholly omitted the economical results from diminished wear and tear of the engines, of the railway, and of the carriages, as had been most especially exemplified on the Dublin and Kingstown Railway where the massy granite blocks originally laid down had been all replaced by longitudinal sleepers, and though the old light 45 lb. rails and 15 lb. chairs were retained, the diminution of the annual maintenance was most remarkable, though there was not a railway in the United Kingdom where so many passengers were carried daily throughout the year.

The expense of keeping up the double way, now that the system of longitudinal timbers has been quite carried out, is less than one-third of the corresponding expense per mile per annum of maintaining the London and Birmingham Railway. Mr. Vignoles then read a variety of tabular results of the cost of the three various systems, going through all the details, and pointing out the exact measures and quantities, and stating the actual expenditure on the upper works of various lines of railway. The result seemed that the bed of the road was duly prepared, including all the items under that for a double line of railway—upper-works, properly laid after the head, which were enumerated in a former lecture, and calculating, for the present heavy and powerful locomotive engine, that no less a sum than £5000, and, in most cases, £6000, per mile was necessary, and that, in many instances, it had reached nearly £7000—the market price of iron and timber, also the quality of the latter, the greater or less facility of obtaining materials for ballast, etc., affecting the amount, and these large sums were independent of the earthwork, masonry, land, fencing management, stations, carrying establishments, etc.

Mr. Vignoles also gave a number of drawings and diagrams contrasting the three systems, and exhibiting, in a very explanatory manner, the modes of laying and fastening. He also exhibited the rail, chair, and fastenings, for the transverse method, with all the recent improvements introduced by Mr. Cubitt on the South-Eastern railway, and as manufactured by Messrs. May, of Ipswich, and then produced the rail with the dove-tailed slot, and the mode of attachment to longitudinal half baulks of timber, repeatedly alluded to in this and the preceding lecture, observing forcibly, that, if the same effective results were obtainable by the latter simple method as by the former complicated one, it was not only to be preferred in this kingdom, but was peculiarly eligible for such countries as Russia, Poland, Germany, in general, France, and America, where wood usually in great abundance, and where iron is comparatively scarce

especially in the form required for railway bars, and, of course, the prices became in proportion. Mr. Vignoles quoted largely from the works and reports of Tredgold, Barlow, and Lecount, and stated a number of mathematical and empirical rules laid down by those authors, which, he stated, were chiefly relating to rails supported at intervals, but, though he felt it right to lay them before the class he considered that further experiments and investigations were requisite, and particularly in reference to the perfect combination in one support of the iron and timber in the longitudinal system, as explained and advocated by him, of which the Professor insisted, the great advantage and peculiarity was that of obtaining a perfect fastening, independent of the fibre of the wood, or the tenacity of the screws or bolts therein, and of obviating the hitherto well-founded objections to the mode of attaching rails having a continuous bearing, which had not been able so prevent a vertical play of the iron on the timber.

CHASM IN THE PRAIRIES.

The last number of Kendall's interesting sketches of incidents connected with his Santa Fe Expedition is as follows:

The morning of the 3d September broke bright and cloudless, the sun rising from out the prairie in all his majesty. Singular as it may appear nearly every shower we had, came in the night from the time we left Austin until we reached the Mexican settlements. Again we spent a couple of hours drying our blankets, then saddled up and pursued our journey, and still in a northwest direction.

We had scarcely gone six miles before we suddenly came upon an immense rent or chasm in the earth, far exceeding in depth the one we had so much difficulty in crossing the day before. No one was aware of its existence until we were immediately upon its brink when a spectacle, exceeding in grandure any thing we had previously witnessed, came suddenly in view. Not a tree or bush, no outline whatever marked its position or course, and we were all lost in amazement and wonder as one by one we left the double-file ranks and rode up to the verge of the yawning abyss.

In depth it could not have been less than eight hundred or a thousand feet from three to five hundred yards in width, and at the point where we first struck it the sides were nearly perpendicular. A sickly sensation of dizziness was felt by all as we looked down, as it were, into the very depths of the earth. Below an occasional spot of green relived the eye, and a small stream of water, now rising to the view then sinking beneath some hugh rock, was bubbling and foaming along. Immense walls, columns in some places that appeared to be arches were seen standing, worn by the water undoubtedly, and so perfect in form that we could with difficulty be brought to believe that the hand of man was not upon them. The rains of centuries, falling upon an immense prarie, had here found a reservoir, and their workings upon the different veins of earth and stone had formed these strange and fanciful shapes.

Before reaching the chasm we had crossed numerous large trails leading a little more to the west than we were travelling, and we were at once convinced that they all centered at a common crossing close by. In this conjecture we were not disappointed, for a trot of half an hour brought us into a large road, the thoroughfare along which millions of Indians, buffalo, and mustangs had travelled for years. Perilous as the decent looked we well knew there was no other near. The lead mule was again started ahead, the steadier and older horses were next driven over the sides, while the more skittish and untractable brought up the rear. Once in the narrow path which led circuitously down the deep decent there was no turning back, and our maddened animals finally reached the bottom in safety. Several large stones were loosened from their fastenings by our men during the frightful decent. They would leap, dash and thunder down the precipitous sides and strike against the bottom far below us with a terrific crash.

We found a running stream at the bottom, and on the opposite side a romantic dell covered with short grass and a few scattering cotton woods. A large body of Indians had encamped on this very spot but a few days previous, the wilted limbs of the trees and other "signs" showing that they had made it a resting place. We too, halted a couple of hours, to give our horses an opportunity to graze and rest themselves. The trail which led up on the opposite side was discovered a short distance above us, to the south, winding up the steep and ragged sides of the precipice.

As we journeyed along this dell all were struck with admiration at the strange and fanciful figures made by the washing of the waters during the rainy season. In some places a perfect wall formed of a reddish clay, were seen standing, and were they any where else it would be impossible to believe that other than the hand of man had formed them. The vein of which these walls were composed was of even thickness, very hard, and ran perpendicularly; and when the softer sand which had surrounded them was washed away the veins still remained standing upright, in some places one hundred feet high and three or four hundred in length.

Columns, too, were there, and such was their architectural order and so much of chaste grandeur was there about them that we were lost in wonder and admiration. In other places the breastworks of forts would be plainly visible, then again the frowning turrets of some castle of the olden time. Cumbrous pillars of some mighty pile raised to religion or royalty were scattered about, regularity was strangely mixed up with ruin and disorder, and Nature had done it all. Niagary has been considered one of her wildest freaks; but Niagara sinks into insignificance when compared with the wild grandure of this awful chasm. Imagination carried us back to Thebes, to Palmyra, and to ancient Athens, and we could not help thinking that we were now among their ruins.

Our passage out of this place was effected with the greatest difficulty. We were obliged to carry our rifles, holsters and saddlebags in our hands, and in clambering up a steep pitch one of the

horses, striking his shoulder against a projecting rock, was precipitated some fifteen or twenty feet directly upon his back. All though he must be killed by the fall; but singular enough he rose immediately, shook himself and a second effort in climbing proved more successful—the animal had not received the slightest apparent injury!

By the middle of the afternoon we were all safely across, after spending five or six hours completely shut out from the world. Again we found ourselves upon the level prairie, and on looking back, after proceeding some hundred yards, not a sign of the immense chasm was visible. The waste we were then upon was at least two hundred and fifty miles, in width, and the two chasms I have mentioned were the reservoirs and at the same time the conductors of the heavy quantity of rain which falls upon it during the wet season to the running streams. The prairie is undoubtedly the largest in the world, and the chasms are in perfect keeping with the size of the prairie.

ON PAINTING TIMBER.

We extract the following observations on painting timber when exposed to damp, by Mr. Lander, from the Professional Papers of the Royal Engineers.

"I beg leave to lay before you a few observations which I have made on the construction and causes of decay in bridges, on the works at Devonport, having been employed on the erection of the bridge at the north-west barrier in the years 1812 and 1813, and also on a large repair in 1837; and I am now employed on a similar repair at the north-east barrier bridge, which, I think, was built in 1816, which has induced me to make the following remarks;—

"1st. These bridges were paved with Guernsey pebbles, which I think, was one cause of decay, as the wet constantly dripped through the joints; an evil which may be avoided by macadamizing, by which such a compact body is formed that the wet cannot get through, and the joists and girders, etc., are thereby kept perfectly dry, besides the advantage of the vibration being very much reduced, as is the case now at the north-west barrier.

2nd. The whole of the wood-work below, as well as the under side of the flooring, was frequently payed over with coal tar, which forming a thick body on the surface, was another, if not the greater cause of decay, as it completely prevented the air from acting on the wood, thereby keeping all moisture within, which of itself is sufficient to decay it. It must be observed that the plank or flooring was so rotten, that in many places it would not bear the weight of the men to work on it, and many of the joists and girders broke into two or three pieces in removing them; some of them were found to be quite dry, and in a similar state to snuff.

3d. As a further proof of the bad effects of paying and paving bridges, I may state that the bridge at the south-east barrier across

the old works leading to Stonehouse, the girders, joists, etc. of which have never been payed or painted, and the road above always macadamized, remains sound and good at this time; and I know this to be a much older bridge than either of the former.

4th. I should state that the timber alluded to above is oak, but I think the same observations will apply to other timber, and in other situations, such as fences; for many posts and rails of the stockade fence here have frequently been found decayed, while in other and older fences, although much worn by time, yet not having been payed or painted, the fibre of the wood remains in a healthy state.

5th. I am also of opinion that skirting to walls, and linings to storehouses and other buildings, if not painted, would last much longer, as the damp from behind would then be allowed to evaporate by the action of the external air.

FRENCH ACADEMY OF SCIENCE.

May 30.—The reading of papers connected with the *accident on the Versailles Railroad* occupied a great portion of this sitting. One of the most interesting was by M. Frangois, an engineer of mines, on the means of preventing the crystalization of iron used in machinery. On the examination of the raptured axle of the engine, which was the cause of the calamity on the 8th ult., the conclusion come to was, that the rupture had been caused by this crystalization, the iron being of the best quality, and of a volume more than sufficient for the purpose to which it was applied. Similar results on other railways have been ascribed to the same cause; but no person has been successful in the means of preventing the recurrence of accident by an improved mode of manufacturing the iron, and all that could be done in the way of precaution was, not to permit iron axles to remain in use for so long a period as to undergo the crystalline change which is so fatal, and of which external appearances give no indication. M. Frangois informs us, that, in a long continued series of experiments, he has observed that a magnetic action upon iron when in a state of fusion, will produce the change alluded to, causing the small and closely adhering grains to crystallize into coarse and larger grains, depriving it of its compact character; and it is inferred that the action of heat upon axles employed in machines, subjected to great velocity, will produce the same effect. This can only be prevented by diminishing the volume of silicate in the iron, by carefully sweating the coal employed in melting, and above all, by the use, in the manufacture of axles, of iron which has already undergone a partial change in its vitreous character, and which, on being reworked, is much less susceptible of crystalline change than new iron. Another communication on the same subject, by Colonel Aubert, was also read. He agrees with M. Frangois as to the cause of the imporfection complained of, but appears to think that the only real precaution is

to change the axles employed in railway locomotives so frequently as not to give time for them to undergo the crystalline change, which is found to be so destructive. Another paper, by Mr. Manby, on the causes of railway accidents, and the means of preventing them excited much attention. This engineer recommends the use of four-wheeled locomotives, but with some important modifications in the construction of them, both as regards the axles, so as to expose them to an inferior degree of stress than upon the present system, and the frame-work of the wheels, which should, he says, be within the wheels, and immediately under the boilers. He also lays down some practical rules for counteracting the liability of locomotives to run off the rails, and mentions several facts in support of the correctness of the various portions of his system.

A paper, by M. Pambour, on the means of *checking, or rather equalizing the velocity on railways, by the use of fans*, deriving a force of resistance in the precise proportion of the velocity communicated by the impetus of a train, was next read.

ON THE ACTION OF AIR AND WATER ON IRON. *By* MR. MALLET.

This is the third report for which the association is indebted to Mr. Mallet. The object of former tabulated results was to determine the actual loss by corrosion in a given time, and the comparative durabilities of rust of the principal kinds of cast iron of Great Britain, and to discover on what durability depended. The tables of experiments now presented show that the rate of corrosion is a decreasing one in most cases, and that the rapidity of the corrosion in cast iron is not so much dependent upon the chemical constitution of the metal as upon its state of crystalline arrangement and the condition of its constituent carbon. The present report, too, extends the inquiry to wrought iron and steel, of which between thirty and forty varieties have been submitted to experiment. The results show that the rate of corrosion of wrought iron is in general much more rapid than that of cast iron or of steel. The finer the wrought iron is, and the more perfectly uniform in texture the slower and the more uniform in its corrosion. Steel corrodes in general more slowly, and much more uniformly, than wrought or cast iron. The results of the action of air and water in the several classes of iron have been examined and chemically determined. The substance spoken of as plumbago was next described. It is produced by the action of air and water on cast steel, especially that in the raw ingot, in the same way as it is in the case of cast iron.

A quantity of plumbago, found in the wreck of the *Royal George* absorbed oxygen on exposure to the air with such rapidity, that it became nearly redhot. Mr. Mallet next described a method of protecting iron by a modification of the zinc process. It was found impossible to cover the surface of iron with zinc, to which it had

no affinity. The first process was to clean the surface of the iron, taking off the coat of oxide, and then immersing it in double chloride of zinc and ammonium, which covered it with a thin film of hydrogen, by which its affinity for the zinc is much increased. The iron was then covered with a triple alloy of zinc, sodium and mercury. Mr. Mallet produced several specimens of his alloy, one of a bolt to be driven into a ship's side, and another a cannon shot covered with his preparation, and exposed to the weather on the roof of a building, and which was perfectly preserved. Cannon balls were so much oxidised by exposure to atmospheric influences that in five or six years they became useless. The French Institute had been engaged in experiments to protect these, and had been compelled to abandon it. Mr. Mallet also brought under the notice of the section a method of preventing the fouling which takes place on the bottoms of iron ships, especially in tropical climates, by means of which new invention he had ascertained plants and animals were prevented from adhering to the ship's bottom.

Another series of experiments related to the rate of corrosion of cast iron, wiought iron, and steel, exposed to atmospheric influences—a matter of great importance to the engineer. The characteristic form of corrosion in air, as contradistinguished from that of water, was also pointed out. This series of inquiries was now complete. The next matter which had eagaged his attention was the rate of corrosion of rails on railways. The general opinion was, that the rails travelled over were not corroded at all. He had been enabled to lay down three sets of rails on the Dublin and Kingstown Railway: one not travelled over, the second in use and not exposed to corrosion, and the third also in use, but made impervious to moisture. The loss of the first was 2·555 of the second 2·344, and of the third 2·650.—results which seemed to indicate that the rail travelled over does corrode more slowly than that out of use. Mr. Mallet concluded by referring to Mr. Nasmyth's theory, that corrorion is checked by the trains passing over the rails always in one direction, and takes place when, as in the case of the London and Blackwall, trains pass both ways.

The Vice-President paid a high compliment to Mr. Mallet on the value of his investigations, and the success which had attended them. The cost to the association of these inquiries was far less perhaps than that incurred by Mr. Mallet in addition to the sum voted him: while the results might have been made more conducive to his private purposes, had Mr. Mallet chosen to conduct them for his private advantage. In reply to a member, Mr. Mallet said that his preparation for the bottoms of iron vessels lasted for about two years and a half in Kingston harbour, in a vessel exposed to a rapid tide-way. He did not think his preparations would answer for copper sheathing. Nothing but copper would protect wood; but he looked forward to the time when the greater proportion of our vessels would be constructed of iron.

ACADEMY OF SCIENCE.

June 20.—A paper by M. Vicat was read, "*On the nature of Pouzzolanes.*—M. Vicat, having discovered the nature of the substance, has been able to compose a substitute with pure clay, calcined whilst exposed to a dead heat, so as to get rid of eight or nine-tenths of the water combined with it. The best clay for the purpose, says this gentleman, is pipe-clay; and in proportion with the admixture of iron, manganese, carbonate of lime or sand, is the defect of quality.

M. Degousee gave an account of some recent results in the making of *Artesian wells.* He states that he has bored for water in the plateau which extends from Lagny to the forest of Arminvilliers, at the height of 110 metres above the Marne. In one spot an abundant supply of water rushed out, although he had gone to a depth of only nine metres. With M. Degousee's report he forwarded to the Academy a letter which he had received from Aime-Bey, the director of the mines of Egypt, who announces his intention of re-opening some of the bored wells of the ancients, at the foot of the Libyan chain, and requests that the necessary instruments may be sent out to him for that purpose.

July 25.—A paper was read by M. Vallee, "*On the mode of rendering the Lake of Geneva subsidiary to the Rhone.*" Amongst the phenomena presented by the Lake of Geneva is one which has particularly attracted the attention of M. Vallee, viz: the sudden changes of level which in the country are called *seches.* He attempts to account for this phenomenon by supposing the existence of a subterranean lake, communicating on the one side with the Leman, and on the other with the high valleys by means of natural wells, which are nearly vertical. In this way he endeavors to explain the rising and falling of the waters at Geneva, which have been frequently noticed to vary as much as two metres at a time, and to account for the rapid and extensive changes which occur in the temperature of the lake.

August 15.—M. Dumas placed before the Academy some specimens of the power of *the newly-invented roller*, by M. Schatteamann which, according to a former report, has been used with great effect in compressing together into one solid mass the fractured portions of the stones used for macadamizing roads. The specimens now submitted to the Academy are of two kinds. In the one the interstices of stone are filled with sand, so compressed as to become as solid as the stone itself: in the other, fragments of stone are rolled together, and form the most complete cohesion.